Engineering 7811 Assignment 3 Part 1 Due: Mon. Feb. 15, 2016

1. For a particular ground-mapping radar application, the desirable radiation intensity of the radar antenna for $0 \leq \phi \leq 2\pi$ is approximated as

$$U_n(\theta) = \begin{cases} 1 \ ; & 0^\circ \leq \theta < 20^\circ \\ 0.342 \csc(\theta) \ ; & 20^\circ \leq \theta < 60^\circ \\ 0 \ ; & 60^\circ \leq \theta \leq 180^\circ \end{cases} .$$

   Determine the maximum directivity in dB.

2. The radiation intensity of a certain antenna is given by $U = \cos^4\theta \sin^2\phi$ for $0 \leq \theta \leq \pi/2$ and $0 \leq \phi \leq 2\pi$. It is zero elsewhere. (a) Determine the directivity and its maximum value in dB. (b) Find the elevation plane half-power beamwidth. (c) Also, sketch U for the y-z plane on a polar plot as well as on a rectangular grid where in the latter case U is the ordinate and θ is the abscissa.

3. (a) Derive the expression for the $\vec{H}$-field far-field for a small loop carrying a current I_0 as given in equation (2.54) of the class notes. (b) Use (a) to derive the far-field $\vec{E}$-field as given in equation (2.55) of the notes. (c) Detemine the radiation intensity and the directivity for the loop. (d) Consider a particular loop which is 2.0 cm in diameter and made of 12-guage aluminum wire. Determine the efficiency and EIRP of the loop when it is operating at 13.56 MHz and carrying a current of 10 mA. Be sure to verify that the loop is a good conductor at the given frequency before determining its efficiency.